

MODULE ONE: BMPF7003

Assessment Component One - Critically evaluate a range of voice related concepts, theories and models that you have recently studied, explaining their relevance to your workplace practice and procedures, and develop a strategy for applying what you have learned to improve your practice and performance. Approx. 2,700 words.

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The development of a rationale for warming-up tailored to the adolescent female singer with reference to expert pedagogue, Janice Chapman.

Introduction

My teaching for a local Instrumental Service is comprised mostly of 20–30-minute lessons with adolescent girls. These are short lesson times, and the time constraints means that warm-ups must be brief and effective and as such I would like to be confident that I am warming up this client group as knowledgeably, economically and effectively as possible. There are consequently two major areas that I have identified for this assignment: the purpose of the warm-up and the content of the warm-up including the use of Semi Occluded Vocal Tract Exercises (SOVTE's) with this client group. I have chosen to apply what I have learnt to Janice Chapman's practice as she is closest to me in terms of pedagogical practice.

The Client Group

The client group is young females between the ages of 7-18 ranging from complete beginners to inexperienced singers. These young people are either approaching or in adolescence and it is vital to explore their specific needs and requirements. There are many researchers who have examined the evident needs of the male adolescent voice during this stage, the most well-known being Cooksey (1977) who drew on the earlier work of Cooper and McKenzie and identified five stages of development. Gackle (1991,2006) argues that voice changes for girls during puberty are also significant and can cause a distressing range of issues from cracking, huskiness, loss of control, inconsistent range to lowering of pitch, and discomfort when singing. In particular, "there is a recognition and resignation to the breathy, thin and often colourless adolescent girls voice" (Gackle 1991, p.18) These varying issues can be attributed to the vocal folds increasing by 3-4mm, and the mutational or glottal chink which Gackle claims Fournier first described in 1866. More recent research by DeBodt (2012) and Sataloff et al (2020) confirms that young females regularly display posterior chinks and that indeed complete vocal fold closure is in fact unusual rather than normative for this age group due to a developmental weakness in the interarytenoid muscles. When the vocal folds do not adduct fully at the back air escapes, hence the characteristic breathiness that Gackle refers to. Gackle has developed a helpful system of female developmental phases included in the appendices. This system has been tested and endorsed by subsequent experts, Sweet (2015) and Yarnall (2006) although as Gackle herself warns these ages and phases are variable, and Yarnall cautions against "lumping them altogether in this dreadful word 'adolescent', and then assuming they are all the same". (Yarnall, 2006 p.81) In the development of a rationale for warming up this group, it would seem sagacious to use Gackle's system as a starting point whilst embracing the uniqueness of each individual. In addition, Skelton (2007) warns that the vocal ligament is not fully functioning until between the ages of 10-13 years and that even at age 16 it is still immature. However, he does not conclude that singers at this age and stage should avoid singing, as has been prescribed historically by Behnke and Brown (1885) cited by Caldretti. (2017) He suggests that the ligament not only matures with age but also with proper use, something confirmed by Chapman "the phonatory mechanisms of the voice strengthens over time with good use and habits" (Chapman, 2017 p. 71). Skelton quotes Cooksey (1977), who argues that vocal training helps to stabilize the voice through the stages of development. If this is the case for boys, then it may be assumed

it is also the case for girls. Indeed Sweet (2015) in her investigation into 14 adolescent female's perceptions of vocal changes found that the girls reported breathing and vocal exercises combined with singing helpful in overcoming phonatory challenges. She highlights the insecurities that many girls feel about their voices particularly when singing with others, the frustrations they feel when their voices do not respond as they would like, as well as the tendency to self-ascribe voice type to themselves (alto or soprano) which can further add to their sense of frustration when their voices change. All subjects in her study who had individual singing lessons reported favourably on vocal and breathing exercises helping them when their voices were behaving unpredictably and Willis and Kenny (2011) in their study of 20 girls aged 12-13 over a year also found that singing training significantly improved the girl's confidence in their voices during this stage of development. This validates the importance of singing training with warming-up for this female age group.

Warming-up

It is important to note that when considering the research on warming-up that most has been undertaken with adult and mixed sex groups, not with adolescent females. I hope to be able to hypothetically apply some of the findings to this group, but further research is needed, and there is crossover relevance from the field of speech therapy; Castillo-Allendes (2021), Ghazi (2021), Gish (2012), McHenry (2008), Keltz (2020), Milbrath (2003), Van Lierde (2011), and Willis et al (2011).

Sataloff, Sandage and Hoch (2018) argue that the main function of warming-up is "skill acquisition, re-establishment of proper technique, and psychological factors related to vocal performance". (Sataloff et al, 2018 p.420) They argue that these are essential skills "to coordinate the respiratory, laryngeal and vocal tract mechanisms in an optimal manner for healthy sustainable singing" (ibid). The warmup provides the teacher with vital diagnostic information and the ability to break down complex motor actions involving these mechanisms into simpler achievable tasks that can then begin to be applied to music.

For many years, evidence for the efficacy of warming-up tended to be anecdotal in nature according to DeFatta and Sataloff (2012), however there is a growing body of evidence that confirms the validity of warming-up the voice as it effectively prepares the body for safe vocal production to ensure that "vocal function is durable and less vulnerable to injury." (DeFatta and Sataloff, 2012 p.422) This must be a high priority with young female voices in a state of flux. Kang et al (2017) helpfully summarizes the measures that are used in diverse studies for establishing efficacious warm-ups. The main aerodynamic measure is PTP = Phonation Threshold Pressure which lowers if a warm-up is effective. Acoustic measures that are used are F0 for which an increase is desirable, whereas decrease is desirable for shimmer, jitter and Noise to Harmonics Ratio (NHR), a measure of acoustic noise. Kang also argues for PTF, phonation threshold flow being more sensitive than PTP, as well as phonation threshold power being valuable. There are a minority of researchers who have questioned the importance and validity of warming-up, notably Duke and Plexico. (2015) Their small-scale study appeared to show that warming-up made no difference to singing power ratio (SPR) or perceived phonatory effort (PPE). Milbrath and Solomon's (2003) study also found that a vocal warm-up did not have any statistical effect on PTP and PPE. However, Milbrath and Solomon recognized the limitations of their study, particularly that a one-off warm-up was never going to be sufficient for this group with chronic vocal fatigue and additionally, Van Lierde et al (2011) along with Kang (2017) agree that PTP is not a sensitive enough measure particularly in this study to detect differences due to warm-up. Gish and Kundak (2012) studied the prevalence of vocal warmups in the singing community and found that 54% always warm up their voices, but despite this 26% still experienced voice problems. Superficially this would seem to suggest that for this 26% warming-up was ineffective, however they also found that for 77% of this group these issues were caused by Gastroesophageal reflux disease (GERD) and allergies. Audible differences pre and post warmup are subtle. Moorcroft and

Kenny (2013) found that although experienced listeners struggled to detect differences in voices pre and post warm-up, they did detect differences in rates of vibrato which were objectively measurable. Notably, they found that warming up made a significant difference for the singer and this is a desirable outcome that must be acknowledged. This is further supported by Elliot, Sunberg et al (1995) as well as findings by Willis et al (2011) and Sweet (2015) with this specific group. Indeed Grebosz-Haring and Thunn-Hohenstein (2017, 2020) found that singing reduces the cortisol levels, a measure of stress in children and adolescents with diverse mental disorders and I can concur that a well led singing warm-up can visibly reduce stress in this age-group. Having acknowledged this, much of the research for warming-up is biased towards the physiological differences that warming-up engenders.

Singers and teachers alike testify to easier vocal use, better timbre, greater range and “a more obedient instrument” (Elliot, Sundberg et al 1995) after warm-up. Research by speech therapists also supports the benefits of warming-up protocols. Ghazi et al (2021) found that warming up had an immediate positive effect on the acoustic characteristics of the voices of female gym coaches. This supported the earlier findings of Van Lierde (2011) who found that a warm-up of around thirty minutes significantly improved the vocal quality of female speech and language therapists. Ghazi et al (2021) were able to substantiate and prove what Van Lierde had hypothesized but did not detect in her study; that there was an increase in f0, decreased jitter, decreased shimmer and decreased NHR proving that vocal warm-ups improve vocal quality.

DeFatta and Sataloff (2012, 2018) and Sataloff, Sandage and Hoch (2018) have sought to apply principles from sports-based research on warm-ups which fascinates me as I am a qualified group exercise teacher. A sports warm-up increases blood flow and muscle temperature which will lead to increased myofibril compliance and reduces the likelihood of injury as well as soreness after exercise. As there are both fast and slow twitch muscle types in the larynx, they hypothesized that this would seem to support the practice of warming up. Elliot, Sunberg and Gramming (1995) argue that an increase in temperature beneficially decreases viscosity in the vocalis muscle. In experiments, Sandage, Wang and Cao (2019) managed to quantify that the upper tissue temperature increased by 0.5 degrees centigrade after a vocal warm-up which in sports science terms, is sufficient to establish optimal muscle function. They argue that this is also likely to promote better muscle metabolism, and that the benefits generally described from singing warm-ups match the benefits of limb skeletal muscle warm-ups. McHenry (2008, 2015, 2016) found that by adding aerobic activity to a vocal warm-up, the female voices benefitted from the increased blood circulation significantly lowering PTP more than just vocal warm-up alone. However aerobic activity alone could not adequately replace a vocal warm-up. In a systematic review of exercise-based injury prevention in child and adolescent sport, Rossler et al (2014) found that there was a 46% reduction in injuries where warm-up strategies were implemented for this group which has massive implications where sports related injuries are far higher in children and young people (Rossler, 2014 citing Mannix, 2013), 32% compared to 9% in adults. Rossler also found that “girls profited significantly more from injury prevention than boys” (Rossler, 2013, p.1743). All this adds credence to the importance and value of carefully warming-up female adolescent voices, and that there may be benefit in introducing some form of aerobic warm-up prior to the vocal warm-up.

Duration

Whilst research has been conducted on the effects of warming-up which will be explored below, Ragsdale, Marchman et al (2020) argue that their study is the first to compare singer's and listeners' perceptions of vocal quality after self-led warm-ups of varying lengths. They found that all singers perceived improved phonatory ease after a vocal warm-up of 5 and 10 minutes, and that there was significant increase in fundamental frequency for the females for the warm-ups of this duration who were all 18-19 years old, just slightly older than the highest

age bracket that I teach. This is encouraging as the length of lesson that I teach necessitates a warm-up of a maximum of 10 minutes in length, however these singers were more experienced than the singers that I teach, specializing at undergraduate level. Gish et al (2012) also concluded that the ideal length of a warm-up is between 5 and 10 minutes. In a survey he found that most singers warm-up for between 5-20 minutes even amongst professionals and longer warm-ups can be contraindicated as they may lead to fatigue. Kang (2017) distinguishes between singing warm-ups and physiological warm-ups devised by speech and language therapists which often include SOVTE's. Kang compared the efficacy of these two types of warm-ups with a group of 26 inexperienced singing participants. Her findings are therefore extremely pertinent to this assignment. She found that straw phonation work was effective in vocal efficiency and fatigue resistance after just 10 minutes of work significantly lowering PTP, whilst 20 minutes of traditional warm-ups was effective particularly in improving acoustic parameters. This would seem to suggest a complementarity of these two different approaches within a vocal warm-up. This makes sense when thinking about the traditional singing warm-up exercises, many of which are SOVT's, the utilization of a straw being a relatively new tool in the singing teacher's toolkit. Water – resistant SOVTE's have been found to be very beneficial in vocal training and warming up the voice. (Castillo-Allendes, Cantor-Cutiva et al 2021) Cardoso. N, and Lucena. J, (2021) compared the value of straight vocalise exercises with vocalise exercises combined with a specific SOVTE exercise using a straw immersed in water and found that gains were made more quickly with the use of the straw in water. They recommend that this SOVTE exercise is used before an artistic warm-up but also caution against using this exercise for too long. Three minutes was considered the minimum to gain significant benefits but warned that the adductor muscles can be tired if used exclusively or excessively. This piece of research has been very insightful for me in warming-up students in a time efficient and effective way as it is proven to show that vocalising with a straw immersed in water may achieve optimal vocal performance in a short time in an easy way for this age group who cannot necessarily easily do other types of SOVTE exercises such as lip trills.

Conclusions

Warming-up is an essential component of voice training with female adolescents, and given outcomes from sports science, may be more significant for females than males. (Rossler et al 2014).

Females may benefit from a small element of aerobic activity as a dimension of their warm-up McHenry (2015, 2016).

Gish et al (2012) and Ragsdale, Marchman et al (2020) show that effective warm-ups can be achieved between 5-10 minutes of duration which is reassuring given the length of the lessons I have with these females.

De Bodt (2012) found that a simple humming SOVTE resonance exercise was most effective in increasing glottic closure with 17–19-year-old females adding credence to the use of SOVTE's for this age group. Kang (2017) found straw phonation work combined with traditional singing exercises to be extremely effective in warming-up the voices of non-singers, and straw phonation work in water is a highly effective option as part of a warm-up strategy, Castillo-Allendes, Cantor-Cutiva et al (2021), Cardoso. N, and Lucena. J, (2021). I would agree with Titze that SOVTE's form a vital part of the singing teachers "arsenal for attacking adduction, register, voice quality or pitch problems." (Titze, 2013, p. 305). SOVTE's have the following benefits all of which are highly desirable when teaching adolescent females; extending upper range Gaskill et al, (2008), better breath management, Nix and Simpson (2008) and Nix (2016), reduced PTP required to initiate and sustain phonation (Titze, 2006) a reduction in load on the phonatory system, Savareh et al (2021), a lower vertical laryngeal position (VLP) (Hijleh et al 2021), the narrowing of the outlet of the larynx which in turns

increases the singers formant cluster (Nix, 2016), the shaping of a rectangular glottis which has better vibratory capacity (Titze, 2013), the ability to safely learn how to manage transglottal and subglottal pressures whilst protecting from “high collision forces in the glottis is an important confluence for singers and teachers alike” (Hijleh et al 2021, p.335). I hypothesize that this is potentially extremely beneficial for a female adolescent student with a breathy sound quality caused by a glottal chink and may result in a “clearer, brighter, and more sonorous” tone quality. (Bele, 2005 cited in Hijleh et al 2021). However, it is important to balance this with Keltz’s warning (2020) that SOVTE’s are not a universal solution, and that even these can be done with poor technique. There is still a place for traditional singing exercises substantiated by Portillo (2018) who found equitable results in electroglottographic and aerodynamic variables for traditional and SOVTE warm-ups.

I conclude that a personalised set of warm-up exercises should be designed for each student utilising the best combination of SOVTE and traditional exercises for them, and I therefore intend to create a resource that categorizes different sorts of exercises and shows a variety of alternative options for exercises that can be selected for individuals within this client group using Gackle’s system (1991, 2006) as a means of assessing which phase each voice is at developmentally. This approach is substantiated by Motel et al (2003) who found that while a standardized warm up was useful, soprano singers required a specific warm up for optimal benefits and Yarnall’s encouragement (2006) to treat female adolescent students as individuals.

(2,912 words)

Reflective Review (1,800 words)

Reflect on my recent learning experience and the value of learning I have acquired. Assess my current competences and identify future development needs in the context of my workplace.

I have used Gibbs Reflective Model (1988) as a means of examining the material I have studied and sought to apply it to this assignment in two ways. Firstly, a micro, weekly diary reflecting on the warm-ups in my lessons which is included in the appendix. Secondly, a macro, overarching summation of the process within the time constraints of this assignment in this review. I like the cyclical nature of this process which has both a sense of completion but also of continuation. I also recognise that Gibb’s model is reflective after the event, so I have also found value in incorporating Schon’s (2016) reflection in action, which manifests itself as a preparedness to be reflecting, flexible and experimental in the moment.

Description

In seeking to develop a rationale for warming-up adolescent female voices, there are several areas which I chose to academically research; Warming-up, what it is, what it does and evidence for it as a strategy. It was extremely helpful to challenge pre-suppositions that I had, such as the importance of a lengthy warm-up, and even to consider the validity of warming-up at all. It was vital to explore research into the adolescent female voice, what is happening, what experiences girls are going through in relation to their voices both physically and psychologically and to consider how to apply research about warming up that has been mostly conducted on adult mixed sex groups to this client group. Lastly, what exercises are useful in warming-up which leads into the huge subject of SOVTE’s which are often an intrinsic part of warm-up protocol with many singing teachers. Each of these are vast subjects worthy of further exploration and focus, as is cool-down which I have chosen not to explore in this assignment. I am also aware that Motor Learning Theory could have also usefully shaped this assignment, particularly as Kang raises this as an issue particularly in relation to SOVTE’s. “With practice, the neural connections that represent the task become relatively permanent (motor learning) and can be used to accomplish similar tasks (generalisability).” (Kang, 2019

p.e8) While acknowledging that it takes time and practice for motor learning to take place which requires repetition, an important element of warm-up exercises, there is a whole further area of exploration into the transfer of skills from SOVTE's into singing which is huge but is outside the scope of this assignment. I foresee further study into this.

My primary teaching expertise is in classical singing technique which is why I have chosen to use Chapman's approach. However, I am also acutely aware that all the adolescent females that I teach are singing in CCM styles so I have to continually draw on my own performance experience as a CCM singer/songwriter. Having investigated the considerations for a classical singing teacher like myself teaching this style in my formative assignment, I am aware of some of the differences, in particular the need for different shaping of the vocal tract and use of resonance, Barlow and LoVetri (2010). For this assignment I will remain within the boundaries of techniques I am familiar and comfortable with, but I am aware that this is a limitation, and I would like to invest in the future in training in specific CCM techniques that can be incorporated into vocal warm-up's that I deliver.

Feelings

This has been a fascinating area to study, although at times the many potential research routes have felt overwhelming. Having taught adolescent females for well over twenty years, I am slightly ashamed that I was not aware of Gackle's research (1991,2006) into the female voice. I was aware of Cooksey's research (1977) into boy's voices and have used an app-based system, "SpeechTest" to assess where boy's voices were developmentally. I have always acknowledged that girls' voices are transitioning too and require careful handling during adolescence, however I was shocked by just how unstable girls' voices can be during this stage of life, which my students have confirmed as I have talked with them. As an experienced singing teacher, this has prompted me to consider how vital it is for new singing teachers to be informed of the research and the ramifications in the studio, as in my experience this is usually the largest client group for most new singing teachers. White affirms my experience that amongst adolescents more females than males' sing. (White, 2001, p.39)

I have mixed feelings about the use of straws. There are numerous options even with the small amount of straw phonation work that I have experimented with.

- 1) Paper straws of 19.5cm length, 0.5cm diameter which are cheap and easy to use, both in and out of water.
- 2) Wider custom-bought 'vocal tubes' that are 33.5cm long and 1.5cm diameter which a few students have invested in both in and out of water.
- 3) Small disposable plastic straws as recommended by Titze which are 12.5cm long and just a few mm thick, slightly harder to source but also extremely cheap and portable.

When I first read the research on the benefits of straw phonation work in water, I was very excited to try these exercises with students, and whilst for some they were helpful, I soon found that students' postures were often compromised by this exercise confirming what Keltz (2020) stated, that even bubbling into a glass of water can be done with poor technique and the outcome can therefore be contrary to the desired result. For students who have yet to establish good posture, this water-based exercise was contraindicated. Although initially anxious about trying the small straws, I found these fun and easy to use, without negatively impacting posture.

In seeking to create economic and efficient warm-up's, combined with worries over young people's boredom thresholds I have reflected that at times particularly at the start of this assignment I have felt hurried in the warm-up process. I have been reminded that the warm-up provides an opportunity for connection and de-stressing with the student, confirmed by Grebosz-Haring and Thunn-Hohenstein, (2017, 2020) and that familiar exercises and rituals can bring both a sense of security and improvement over time which is what Chapman (2017)

refers to. Identifying the balance of familiarity and originality is a tension that I have more readily identified as I have reflected on the process of warming-up. As I have increasingly relaxed, I have also enjoyed the process of being more reflective in action (Schon 1983), being more experimental and improvisational with my warm-ups as I have read about various techniques, how to implement them and daring to explore combinations of old and new ideas. I have also questioned and experimented with a more holistic approach to warming up, both in terms of the whole body, but also in redefining the boundaries and blurring the edges of what constitutes warming-up and what does not. For example, I have experimented with playing catch with a ball with vocalisations as a means of engaging the body and breath with the voice, as well as using intervals or phrases of music as warm-up exercises or singing a song using an SOVTE. It is stimulating for student and teacher to be versatile and experimental, but vital for the teacher to be sensitive to what exceeds the comfort zone too far for adolescent students. I have found instinct to be vitally important when reflecting in action.

Evaluation

The research into adolescent girls' voices is relatively limited (Gackle 1991, 2006, Sweet 2005, Willis and Kenny 2011, Caldretti 2017) and although these studies do attest to the benefits of voice lessons and warm-up protocols anecdotally, there is currently no research that I found into the effects of warming up girls' voices in terms of acoustic measures. Research by De Bodt et al (2012) is the nearest study that I have found which suggests that SOVTE's specifically help better vocal fold closure in this age group. Humming on an 'M', a type of SOVTE helped to increase glottal closure when compared to other exercises and led to "better vocal quality". (DeBodt 2012 p. 818 e3) More research is needed into effective warm-up protocols with female adolescents, and to test which SOVTE exercises are most effective, although I suspect that this will be very individualised. SOVTE exercises help raise both the supraglottal pressure and the intraglottal pressure which "lessens the impact on the vocal folds" (Hijleh and Pinto 2021 p.334) and creates a clearer, less breathy tone which is clearly desirable for this group. Evaluating diverse SOVTE exercises with certain students with breathy tone to see if any exercises specifically improve breathiness is one area I would like to analyse in more depth. I concur with Chapman that for this client group, the voice will improve in time with age and good technique. She suggests repetitive exercises that "develop the strength and endurance of the torso...development at the level of the vocal folds can then follow naturally". (Chapman, 2017 p.72) She endorses SOVTE's for this, use of rolled 'r', lip trills and voiced fricatives.

Analysis

Adolescent females are often the largest proportion of students for the general practice singing teacher. Their voices have unique challenges during this timeframe that many singing teachers can be largely unaware of. Thankfully with "the good use and habits" (Chapman, 2017, p.71) that most singing teachers instil in their students through warm-up protocols and anecdotal trial and error, this group will usually develop and improve. However, it would be beneficial for teachers to be better equipped with Gackle's (1991, 2006) system of assessment, and exercises that deliver specific outcomes which are tried and tested scientifically.

Conclusion

Adolescent girls' voices are transitioning through almost as much change as boys. I have found that this study has prompted me to facilitate conversations with my students about what is happening. These have already proved invaluable as girls have shared about the struggles with their voices and been reassured by the normality of the changes that they are experiencing. This assignment has convinced me that warming-up is a vital component in a singing lesson, and there are a plethora of exercises and tools available to the teacher which achieve similar outcomes but with different means. This study has helped me to be able to begin to organise exercises into diverse categories in order to find the most effective bespoke set of exercises for any given individual. For example, it is possible to sing a scale with a

variety of semi-occluded means, using a straw, lip trill, rolled r for example, all of which deliver similar benefits, but some exercises will be optimal for certain students.

Devise a detailed personal development plan which incorporates identified areas for development, objectives, activities to be undertaken, methods, resources, review periods and timescales.

Development Plan

- Incorporate Gackle's phases of development. Begin to assess and re-assess students' voices on a regular ongoing basis. (See appendix)
- Write a warm-up development plan for each of my students with reference to the "respiratory, laryngeal and vocal tract mechanisms" (Sataloff et al, 2018 p.420). Assess which exercises work with each individual and why. End of summer term.
- Detail and analyse exercises I currently use for this age group to include in this assignment. (See appendix). Reflect on which exercises I use with students and why.
- Analyse Chapman's general approach and exercises and analyse how appropriate they are for this age group. Allow her exercises to inform my 'reflection in action' with students during summer term 2022. Reflect on which exercises were successful and worthy of incorporating.
- Design a manual for new teachers with a range of exercises appropriate for this age range. Potential project for consideration as part of this MA.
- Invest in LoVetri's somatic voice training in the future to increase my knowledge of CCM vocal techniques. Further professional development after this course.
- Explore an assignment on Motor Learning Theory as part of this course.
- Learn how to use the International Phonetic Alphabet in a basic form in order to be able to use it to describe exercises. (This assignment)

(1,994 words)

Glossary

CCM – Contemporary Commercial Music

Bibliography

Barlow, C. LoVetri, J. (2010) 'Closed quotient and spectral measures of female adolescent singers in different singing styles' *Journal of Voice*, 24 pp. 314-318

Barrett, E. Lam, W. Yiu, E. (2018) 'Elicitation of minimum and maximum fundamental frequency and vocal intensity: discrete half steps versus glissando' (2018) *Journal of Voice*, 34 (2) pp.179-196

Caldretti, M. (2017) '*Vocal pedagogy and the adolescent female singing voice*' California State University, Long Beach. ProQuest Dissertations publishing 10263755

Castillo-Allendes, A. Cantor-Cutiva, C. Hunter, E. (2021) 'Acoustic effects of vocal warm-up: A seven-week longitudinal case study' *Journal of Voice*
<https://doi.org/10.1016/j.jvoice.2021.09.030>

Cardoso, N. Lucena, J. et al (2021) 'Do flexible silicon tubes immersed in water combined with vocalise improve the immediate effect on voice?' *Journal of Speech, Language and Hearing Research*, 64 pp. 4535-4562

Chapman, J. (2017) '*Singing and teaching singing: a holistic approach to classical voice*' Third edition, Plural Publishing

Cooksey, J. (1977) 'The development of a contemporary eclectic theory for the training and cultivation of the junior high school male changing voice: Part 1 Existing theories' *The Choral Journal*, 18 (2) pp. 5-14

Cooksey, J. (1977) 'The development of a contemporary eclectic theory for the training and cultivation of the junior high school male changing voice: Part 2 Scientific and empirical findings: some tentative solutions' *The Choral Journal*, 18, (3) pp. 5-16

Cooksey, J. (1977) 'The development of a contemporary eclectic theory for the training and cultivation of the junior high school male changing voice: Part 3 Developing and integrated approach to the care and training of the junior high school male changing voice' *The Choral Journal*, 18 (4) pp. 5-15

De Bodt, M. et al (2012) 'The impact of phonation mode and vocal technique on vocal fold closure in young females with normal voice quality' *Journal of Voice*, 26 (6) pp. 818 e1-818 e4

DeFatta, R. Sataloff, R. (2012) 'The value of vocal warm-up and cool down exercises-questions and controversies' *Journal of Singing*, 69 (2) pp. 173-175

Duke, E. Plexico, L. et al (2015) 'The effect of traditional singing warm-up versus semi occluded vocal tract exercises on the acoustic parameters of singing voice.' *Journal of Voice*, 29 (6) pp. 727-732

Elliot, N. Sundberg, J. and Gramming, P. (1995) 'What happens during vocal warm-up?' *Journal of Voice*, 9 (1) pp. 37-44

Finlay, L. (2008) '*Reflecting on reflective practice*' A discussion paper prepared for PBPL CETL, PBPL paper 2
www.open.ac.uk/pbpl.

Gackle, L. (1991) 'The Adolescent female vocal characteristics of change and stages of development' *The Choral Journal*, 31 (8) pp.17-25

Gackle, L. (2006) 'Finding Ophelia's voice: the female voice during adolescence' *The Choral Journal*, 47 (5) pp. 28-37

Gaskill, C. (2008) 'The effect of a voiced lip trill on estimated glottal closed quotient' *Journal of Voice*, 22 (6) pp. 634-643

Ghazi, S. Jameli, J. Ghaemi, H. (2021) 'Investigating the effects of warm-up exercises on acoustic characteristics of voice in female gym coaches' *Journal of Voice*
<https://doi.org/10.1016/j.jvoice.2021.06.017>

Gish, A. Kunduk, M. et al (2012) 'Vocal warm up practices and perceptions in vocalists: a pilot survey' *Journal of Voice*, 26 (1) pp. e1- e10

Grebosz-Haring, K. Thun-Hohenstein, L. (2017) 'Psychobiological responses to musical activities in children and adolescents with mental disorders' *Psychoneuroendocrinology*, 83, pp. 84-84
<http://dx.doi.org/10.1016/j.psyneuen.2017.07.462>

Heydon, R. Fancourt, D. Cohen, A. (2020) '*The Routledge companion to inter-disciplinary studies in singing*' First edition, chapter 5
Grebosz-Haring, K. Thun-Hohenstein, L. (2020)
'Singing for health and wellbeing in children and adolescents with mental disorders'
<https://doi.org/10.4324/9781315162546>

Hijleh, K. Pinto, C. (2021) 'Realizing the benefits of SOVTEs: A reflection on the research' *Journal of Singing*, 77 (3) pp. 333-344

Kang, J. Xue, C. et al (2017) 'Comparing the exposure-response relationships of physiological and traditional vocal warm-ups on aerodynamic and acoustic parameters in untrained singers' *Journal of Voice*, 33 (4) pp. 420-428

Kang, J. et al (2019) 'Lingering effects of straw phonation exercises on aerodynamic, electroglottographic, and acoustic parameters.' *Journal of Voice*, 33 (5) pp. 810 e5 -810 e11

Keltz, A. McHenry, M. (2020) 'Steam and/or semi-occluded vocal tract exercise as morning warm-up strategy' *Journal of Voice* 2020-09-25
<https://doi.org/10.1016/j.jvoice.2020.08.037>

McHenry, M. Johnson, J. Foshea, B. (2008) 'The effects of specific versus combined warm-up strategies on the voice' *Journal of Voice*, 23 (5) pp.572-576

McHenry, M. Evans, J. (2015) 'Aerobic Exercise as a warm-up for singing: Aerodynamic changes' *Journal of Voice*, 30 (6) pp. 693-697

McHenry, M. Evans, J. (2016) 'Aerobic Exercise as a warm-up for singing: Acoustic Impacts' *Journal of Voice*, 31 (4) pp. 438-441

McHenry, M. Evans, J. Powitzky, E. (2012) 'Singers' phonation threshold pressure and ratings of self-perceived effort on vocal tasks' *Journal of Voice*, 27 (3) pp. 295-298

Milbrath, R. Solomon, N. 'Do vocal warm-up exercises alleviate vocal fatigue?' (2003) *Journal of speech, language and hearing research*, 46 (2) pp. 422-436

Moorcroft, L. Kenny, D. (2013) 'Singer and listener perception of vocal warmups' *Journal of Voice*, 27 (2) pp. 258 e1-258 e13

Motel, T. Fisher, K. Leydon, C. (2003) 'Vocal warm-up increases phonation threshold pressure in soprano singers at high pitch' *Journal of Voice*, 17 (2) pp.160-167

Nix, J. (2016) 'Closing your mouth to 'open' your sound' *Journal of Singing*, 73 (1) pp. 35-41

Nix, J. Simpson, B. (2008) 'Semi-occluded vocal tract postures and their application in the singing voice studio' *Journal of Singing*, 64 (3) pp. 339-342

Portillo, M. et al (2018) 'Comparison of effects produced by physiological versus traditional vocal warm-up in contemporary commercial singers' *Journal of Voice*, 32, (2) pp. 200-208

Ragsdale, F. Marchman, J. et al (2020) 'Quantifying subjective and objective measures of singing after different warm-up durations' *Journal of Voice*
<https://doi.org/10.1016/j.jvoice.2020.08.005>

Rossler, R. Donath, L. et al (2014) 'Exercise-based injury prevention in child and adolescent sport: a systematic review and meta-analysis' *Springer International publishing Sports Medicine*, 44 (12) pp.1733-1748

Sandage, M. Wang, S. Cao, G. (2019) 'Upper Airway thermoregulation during singing warm-ups' *Journal of Voice*, 35 (1) pp. 157 e1 -157 e6

Sandage, M. Hoch, M. (2018) 'Exercise physiology: Perspective for vocal training' *Journal of Singing*, 74 (4) pp. 419-425

Sataloff, R. Sandage, M. Hoch, M. (2018) 'Care of the professional voice. Exercise physiology: Perspective for vocal training' *Journal of Singing*, 74 (4) pp. 419-425

Sataloff, R. Kost, M. (2020) 'The effects of age on the voice. Part 1' *Journal of Singing*, 77 (1) pp. 63-70

Savareh, S. Moradi, N. et al (2021) 'Immediate effects of semi-occluded vocal tract exercises as a vocal warm-up in singers' *Journal of Voice*
<https://doi.org/10.1016/j.jvoice.2021.05.014>

Schon, D. (1992) 'The reflective practitioner: how professionals think in action' First Edition Routledge
<https://doi.org/10.4324/9781315237473>

Skelton, K. (2007) 'The child's voice: a closer look at pedagogy and science' *Journal of Singing*, 63 (5) pp. 537-544

Sweet, B. (2015) 'The adolescent female changing voice: a phenomenological investigation' *Journal of research in music education*, 63 (1) pp. 70-88

Titze, I. (2006) 'Voice training and therapy with semi-occluded vocal tract: rationale and scientific underpinnings' *Journal of Speech, Language and Hearing Research*, 49 (2) pp. 448-449

Titze, I. (2013) 'One more small step in solving the mystery of the benefits of semi-occluded vocal tract exercises' *Journal of Singing*, 69 (3) pp. 305-306

Van Lierde, K. D'haeseleer, E. et al (2011) 'The impact of vocal warm-up exercises on the objective vocal quality in female students training to be speech language pathologists.' *Journal of Voice*, 25 (3) pp. e115-e121

Willis, E. Kenny, D. (2011) 'Voice training and changing weight – Are they reflected in speaking fundamental frequency, voice range, and pitch breaks of 13-year-old girls? A longitudinal study' *Journal of Voice*, 25 (5) pp. e233-e243

White, C. White, D. (2001) 'Common-sense training for changing male voices' *Music Education Journal*, 87 (6) pp. 39-53

Yarnall, S. (2006) 'Vocal and aural perceptions of young singers aged 10-21' *Journal of Singing*, 63 (1) pp. 81-85

Appendices

Diary

22.2.22

Description

Having been persuaded by Cardoso's findings (2021) that SOVTE straw immersion vocalisations are a fast and economic way to warm-up the voice I decided to use these more purposefully in my warm-up's with the students that I teach on a weekly basis. I had started to include these with students but not in any systematic way. I decided this week to demonstrate certain breathing and voiced exercises with the straw for students to try in the lessons, and to adopt into their practice regimes.

The first issue that I faced was sourcing the two pieces of equipment, a straw and water. I was able to provide paper straws for students but not water for every student, so the first issue was that every student had a straw but not every student could immerse it in water. In order to be able to analyse the efficacy of this technique it is vital that students have access to these two items. I can guarantee a straw but found this week that I was in the hands of the students for provision of water. I asked students who did not have water with them to bring water bottles to next weeks lesson. This unfortunately may be an unreliable means of ensuring students have water bottle so I may look at providing cheap bottles of water for next week's lessons although this is not a viable long-term solution. I was still able to work with the straw in air which is valid but is different from straw immersion in water.

Feeling

I had mixed feelings about the use of this technique in lessons and felt that it was successful with certain students and not with others. The whole point of this type of warm-up is to find a time-economic way to effectively warm the voice up. It felt very frustrating when time was wasted finding equipment. I also had mixed feelings about the exercise in that when the students were able to blow into water, I could not effectively hear the pitches or sound that they were producing so I found the lack of auditory feedback very frustrating. As a teacher who needs auditory information to assess and monitor the vocal instrument this felt like I was being partially disabled which left me with questions about the long-term use of this exercise in lesson time. However, there were times when the student and I had a lot of fun with the exercise, and it was a happy and constructive exercise.

Evaluation

This exercise was effective for some students and not for others which concurs with Motel et al (2003) who found that effective warm-ups need to be specific to individuals. It is a useful

alternative to a voiced lip trill, another type of SOVTE exercise which I have used a lot with students. Some students just cannot manage a lip trill, so the straw immersed in water exercise was a fun alternative that requires no skill, just equipment and achieves a similar outcome. I found that it was particularly good with younger students who enjoyed the experience of blowing into a glass of water, something that might be regarded as unacceptable behaviour in a mealtime setting. I found it to be a useful exercise in relaxing students and creating a happy atmosphere.

One of the major disadvantages of this technique is that in bringing the straw to the lips, it can contribute to poor posture. Nearly every student craned their neck slightly to reach the straw and I had to clearly instruct them to bring the straw up to the right position rather than taking their head to the straw which was the natural tendency. I had to make this teaching point continually and was very concerned that they would not remember this at home. One student who was keen on the exercise has particularly poor posture, and it exacerbated. I was not convinced it was the right exercise for her at this moment in time.

Analysis

In order to make a judgment about the efficacy of this exercise, it requires that two vital pieces of equipment are present, namely a straw and a container of water. It is impossible to assess how useful this exercise is with each student until a regular habit with good technique has been established with the equipment. New habits with this age group take a few weeks to establish and it also takes time for a new exercise to be learnt correctly. Although I had variable success with the exercise with those who had the equipment, I need to give the students time to learn to do the exercise correctly and continue to evaluate for a few weeks whether it is useful to each specific student. I had two main concerns about the exercise, firstly the postural modifications that students made to use the straw, and secondly the lack of auditory information that I was able to glean from the exercise. I will need to continue to evaluate whether the exercise can be mastered without disturbing posture. It potentially could create an alternative learning opportunity for a student to learn about their posture and improve upon it whilst using the equipment, or it may be that using the equipment overloads the student and the exercise then becomes contraindicated.

Conclusion

This exercise, like any new exercise, requires proper technique and practice. It is my job over the new few weeks to ensure that students are approaching and doing exercises with the straw correctly. It may require two to three lessons to be able to assess how useful the exercises are with each student.

Action Plan

Ensure I have straws and water available for next week's lessons.

Revise teaching technique for straw exercises. Do some prior work on posture and devise a game or way to ensure that this is not disturbed.

Use mirror for exercise so that the student can see what they are doing and can learn to self-correct so that they are equipped for doing the exercise at home on their own.

Two areas for further study

I know from the vocal first aid course that I did that straw work is still valid when not immersed in water, but I would like to study the validity of straw work in air and whether this can be used as effectively and if so, how best to use this technique for when water is not present.

Study the efficacy of the voiced lip trill as an alternative warm-up technique.

28.2.22

Description

Having bought water bottles for my students this week to try the straw phonation work in water, I changed my mind for three reasons; The water bottles were bulky to take in along with the

large bag of music I carry, I was not persuaded by the head positioning that leaning over a water bottle encourages, and thirdly and most significantly I watched Debbie Winter's presentation on SOVT's and in particular was intrigued by Titze's recommendations on warming up. He advocates for the following order;

- A) Small diameter, highly resistant straw
- B) Large diameter, less resistant straw
- C) Bilabial or labiodental fricatives
- D) Lip or tongue trills
- E) Nasal consonants
- F) Vowels /u/ and /i/

I was persuaded by his research on small straws encouraging a rectangular shaped glottis and parallel vocal fold surfaces, and using a small lightweight straw is both cheap, easy to provide and less likely to impinge on posture. (Titze 2013) Although I did not have the very small straws that he recommends, I did have normal straws with me which were immediately accessible, so I decided to try his warm-up exercises with my students. These were gliding from low to high through the whole vocal register, short glides with accents encouraging use of the abdominals and singing a melody with the tube. I added on a 'v' fricative, again encouraging a swelling of the sound with the abdominals, lastly ending with scale vocalisations on either a lip trill or through the straw, finishing with this same exercise repeated on an 'ooh'.

Feelings

I was excited by Titze's findings and by his ordering of efficacy of exercises. I felt that this ordering gave me a shape to hang exercises on, but was very flexible as well. Having bought a wide vocal straw specific for purpose at great expense, I had been trying to find equivalent straws for students at a much more affordable price. Having researched purchasing small narrow straws, I was encouraged that these are very affordable for me to have a supply of, and so am going to purchase some for trying with my students next week. In the meantime, the normal size drinking straw was an easy alternative. I also felt excited that suddenly I am beginning to understand what exercises to do in which order for maximum effect for the students I teach who are mostly beginner level as well as in some cases quite young. I feel that the above order of exercises gives me structure to hang my exercises and to experiment with diverse exercises according to specific students. My academic research is beginning to show me that voices are individual and require individualised exercises depending on experience and ability however having a warm-up framework such as his above is helpful. Enflo, Sunberg et al found that straw phonation was more effective in warming up beginners than advanced singers which encouraged me that finding an effective way to use straws with my students who are mostly beginners was worthwhile.

Evaluation

Using Titze's straw exercises was a very good starting point for all my students. They were easy to instruct and just using a straw with no water was much easier to navigate in the lesson and less intrusive on posture. Me having a supply of cheap straws with me meant that there was no issue with students not having the right equipment with them, and not having to use or remember water was helpful. Every student was able to do his exercises from the youngest to the most experienced, and I could also hear the sound which was also far preferable to the straw phonation in water. I could hear every student sliding through their range and was encouraged by the way all of them managed to negotiate through register shifts. I could also hear whether they were in tune or not when it came to the vocalisations.

Analysis

The straw exercises without water were far preferable to straw exercises with water because they require less equipment, plus as a teacher I receive far better auditory feedback from them and can hear what is happening. The straw exercises were a time efficient, economic and easy way to warm-up every student's voice. They were a quick check in with those who were more experienced who had done a vocal warm-up earlier in the day, and they were very

effective with my younger students, and I could immediately hear the benefits from them. I witnessed greater breath management (Titze 2006) and a clearer more resonant sound in all my pupils possibly because as Titze and Laukkanen (2007) found students get buzzing sensory feedback in the lips and mouth which is apparently a useful indicator of epilaryngeal narrowing.

Conclusion

I had intended to persevere with straw phonation in water this week but decided to change direction based largely on Titze's research with small narrow straws. Straw phonation without water is far easier to administer, less compromising on posture, potentially more efficient according to Titze for my purposes of warming-up young voices and supplies me with far better auditory information. I will not be attempting straw phonation work again as a warm-up with my students but will reserve it as a therapeutic strategy.

Action Plan

Examine Titze's research more carefully.

Buy small straws to try with students next week, as I am aware that I have not done his exercises exactly as he recommends because of the size of the straw I was using.

7.3.22

Description

I had wanted to continue with the straw phonation work today, and specifically trial thin straws that Titze advocates, however I had run out of normal straws today and was waiting for a delivery for thin straws. This hindered the straw phonation work I could do with students today. My research this week has also taken me in a slightly different direction as I have studied the literature available on the female changing voice and led me to Lynne Gackle's work and classification system. Although I had a lot of absences today, I decided to attempt to classify my student's voices, by listening to their speaking voice and finding the relative pitch on the piano, as well as finding their current upper and lower pitches in a more systematic way. Even with the minimal students I had today, I had students in every phase of development which was fascinating to see.

Feelings

I felt a little frustrated by not having straws in certain lessons and acknowledge how useful the straws have been in warming up students voices over the past couple of weeks. I was also frustrated by the large number of students forgetting lessons, as I knew they were all in school but impossible for me to find. This always plays slightly into your fears that maybe your lessons are not as exciting as you would like them to be. This led me to question again how you can create effective warm-up and technical work in ways that are fun and engaging for students. The students I did have I worked especially hard with to make the lessons as scintillating and fun as possible, and these were very positive. It was useful to use Lynne Gackle's voice assessments, and these gave me an opportunity to educate the girls about changes that they may be experiencing in their voices. One girl is quite self-conscious about her voice when it cracks and doesn't do what she wants it to. It was very reassuring for her to hear that this is a very normal developmental issue, and I could see her visibly relax when I explained this to her.

Evaluation

I found Lynne Gackle's tests relatively easy to deliver, and I think students were interested to hear about why I was doing them. I found all the voices fitted her phases and I wondered if perhaps going through all the tests was necessary on a regular basis, as most of them fitted

the phases according to their ages. However, it was good to have some baseline data recorded in a systematic way for these female voices.

Analysis

Thinking about each voice in a systematic way was very constructive, and particularly registering in a conscious way the common vocal issues that girls are having with their voices was helpful in refining my goals and repertoire choices with them.

Conclusion

Lynne Gackle's phased system is something to be adopted into my future teaching practice, and to be utilised in a developing rationale for teaching female adolescents.

Action Plan

Research the use of thin and wider straws in order to trial varying sized straws with students next week.

Thinking about ways to make technical work fun and enjoyable is a priority and needs to be a major consideration as I seek to apply theory to practice.

15.3.22

Description

Although the thin straws had arrived, I had not been able to do the study this week I intended to regarding using these straws, so I delayed this work for another week. Many students were present who had been absent last week, so I continued with Gackle's classification work. I also had normal size straws with me, so continued with warming up my student's voices using these without water.

Feelings

There is an economy to routine warm-up exercises that means you can quickly conduct an exercise without lots of introduction. I was able to dive quickly into glissandi with the straws and add other exercises with and without the straw with students who are getting used to me. This is the positive element of the straw work. The negative element is that it does not feel like singing and is not a particularly satisfying exercise to do. There is something about vocalisation exercises that are more satisfying to do as a student and listen to as a teacher. I worry about the boredom threshold of these young people, and how convinced they are of the usefulness of this work.

Evaluation

Gackle's system was useful again with students as a means of monitoring their voices. It also opened conversation with certain students about things that they were struggling with vocally. This was extremely helpful, and very reassuring for students. I perhaps had not been quite so aware before of how many girls worried about their voices and were aware of things their voices would and wouldn't do. It is not always easy to identify which note on the piano is nearest to a girl's speaking pitch, and it was easier with some voices rather than others. I suspect that this gets easier as you use the system more frequently.

The glissandi straw work is a fairly easy access exercise that everyone can do, although it is not particularly rewarding to do and there were some issues with straw technique that required correction; lip shape around the straw which changed for certain students as they changed pitch, moving the straw up and down according to pitch, blowing air into the cheeks instead of sending the sound down the straw, and sending sound into the nose as well. The jaw also can get stiff in this position, so some work to release jaw and tongue was important with certain students.

Analysis

Using Gackle's system is relatively straightforward, worthwhile and worthy of inclusion in a teaching strategy for this group.

Routine and innovation are issues to be balanced when considering warm-up strategies.

Even straw work requires correct technique, but these issues can be highlighting issues that translate into singing. One of the useful outcomes of straw phonation work is the ability to begin to feel resonance in the correct places, and incorrect technique can highlight where a student is placing the sound and airflow.

Conclusion

Gackle's system is very helpful in determining what stage of development a voice is at. I will be using Gackle's system from now on with this group.

The straw work highlighted issues of technique with certain students in terms of placement and resonance, and I am hopeful that with increasingly better technique applied to this work, that this will reap rewards with these students when they sing.

Action Plan

Exploring other exercises with the straws that might be straightforward but give some variety. Actively incorporate jaw and tongue exercises into the warm-up strategy where straw work does not address these issues.

Explore research into use of different sized straws.

22.3.22

Description

I decided to trial the very thin short straws in lessons this week. I also decided to trust my instincts and be experimental with my students, as I felt like I had gotten overly self analytical and this was undermining my confidence and the potential for fun in the warm-up. I also had a tennis ball with me and decided to play 'catch' with some of my younger students as a means of relaxing them and connecting their sound to their breath. We vocalised on an 'ooh' sound as we threw the ball, and experimented with pitch mirroring the height of the ball. This was also a gently aerobic activity which increased the heart rate. (McHenry 2015, 2016) I sought to be creative with the straws, the ball, and vocalisations moving to lip trill exercises.

Feelings

I was nervous about trying the short straws because I am aware that they create considerably more resistance which I was unsure about with my beginner students. There was an improvisational and experimental element to the warm-up that both I and the students clearly enjoyed whilst there was also a familiar structure to the warm-up too. This felt like a successful combination.

Evaluation

The ball exercise was a brilliant means of connecting breath to sound and enabling students to relax and connect more to both their breath and their body. It also introduced the element of fun and play which relaxed students and improved mood and focus.

The short straws were also surprisingly successful. I think this was partly due to students already being used to straw work. They enjoyed the novelty of a different size straw, and the straws were so tiny that they did not compromise posture at all.

Analysis

I observed immediate benefits to both strategies I employed today. The ball work was fun and effective, as was the small straw work. I observed better use of breath, and the sound from all my students had better clarity.

Conclusion

Despite being nervous of using the small straws, they were extremely effective and I will incorporate these into my practice on a regular basis.

Action Plan

Finding other resources to make lessons fun, engaging and effective is definitely something I want to explore more.

Characteristic Stages of Development In the Adolescent Female Voice

(Gackle 1991)

Note: Chronological ages are given as general guides and certainly should not be used as definitive.

Stage I: Prepubertal - Ages 8 - 10 (11).

Speaking Voice: Average fundamental frequency - 260 Hz - 290 Hz (C4 - D4); * Acceptable limits: 225 Hz - 350 Hz (A3 - F4).

Singing Voice: Light, flute-like quality; - No apparent register breaks; - Soprano quality; - Flexible, able to manage intervallic skips; - Much like the male voice at the same age with the exception that the female voice is lighter in weight because the volume potential is generally not as great. Depending on other physiological changes (i.e., breast development, menarche) this stage could continue through age 12 or 13.

Stage IIA: Pubescence/Pre-Menarcheal: Ages 11 to 12 (13); Beginning of mutation;

First signs of physical maturation begin (breast development, height increase, pubic hair, etc.).

Speaking Voice: Average fundamental frequency is 245 Hz - 275 Hz (B3 - C-sharp4); 'Acceptable limits - 235 Hz - 290 Hz (A-sharp3 - D4).

Singing Voice: Breathiness in the tone due to appearance of mutational chink, an inadequate closure of the vocal folds as growth occurs in the laryngeal area; - Register break appears between G4 and B4; - If not using lower (chest) voice, there is apparent loss of lower range - around C4 (Some girls have trouble producing chest voice at this time.).

Symptomatic Signs: - Difficulty or discomfort with singing; - Difficulty in achieving volume (especially in middle and upper range); - Breathy tone throughout upper range (head voice). - Fuller tone in lower/chest range; obvious flip into breathy, child-like, fluty voice at transition from lower to upper registers.

Stage IIB: Puberty/Post-Menarcheal: Ages 13 - 14 (15); Peak of Mutation.

Speaking Voice: Average fundamental frequency: 225 Hz - 275 Hz (A3 - C-sharp4); 'Acceptable limits: 195 Hz - 290 Hz (G3 - D4); Huskiness is inherent, but the voice begins to change in weight and timbre.

Singing voice: Very critical time; After the Stage IIA, (Pre Menarcheal), tessituras can move up or down, or sometimes, can narrow at either end, yielding basically a five- or six-note range of comfortable singing.

- Register breaks still apparent between G4 and B4, and also at D5 to F-sharp5;
- At times, lower notes are more easily produced, yielding an illusion of an alto quality; singing in this range may be easier and can be recommended for short periods of time; singing only in the lower range for an indefinite period of time can be injurious to the young unsettled voice because of the tendency to overuse the lower (chest) register.
- Vocalization should occur throughout the vocal range, always striving to avoid any unnecessary strain in the lower or upper range.
- Because the changes during this stage are sporadic and unpredictable, it is necessary to listen to individual voices frequently in order to assess vocal development.

Symptomatic Signs:

- Hoarseness without upper respiratory infection;
- Voice cracking;
- Difficulty or discomfort with singing;
- Lack of clarity in the tone.

Stage III: Young Adult Female/Post-Menarcheal: Ages 14 - 15 (16).

Speaking Voice: Average fundamental frequency is 210 Hz - 245 Hz (G-sharp3 B3); 'Acceptable limits: 185 Hz - 260 Hz (F-sharp3 - C4);

- Timbre approximates that of adult female;
- More richness appears in the voice quality.

Singing Voice:

- Overall range capabilities increase. (At times, range does not decrease during the time of mutation. One characteristic of a quality singing voice is that it encompasses a large range. This does not imply that any voice is an alto at age 15-16 simply because those tones are within the young singer's capability) ;
- Greater consistency occurs between registers; voice breaks are more apparent at passaggio D5 - F-sharp5 (more typical of adult voice) ;
- Breathiness appears to decrease; - Tone, though not as full as mature adult, is deeper and richer;
- Ease returns in the singing process;
- Vibrato appears in the voice;
- Volume, resonance, and vocal agility increase. * Acceptable limits were derived from Voice Problems of Children by Kenneth Wilson, and do not necessarily reflect physically efficient use of voice in speech

Exercises and their categorisation.

SOVTE's (Nix and Simpson 2008)

Group one. Sustained semi-occlusion: Exercises with a single source of vibration. Humming, hand over mouth, and straw in air. 'Steady' exercises. CQr (Closed quotient range) values close to singing on an ah vowel

Group two. Oscillatory semi-occlusion: Exercises with two sources of vibration, lip trills, tongue trills, and Lax Vox. "Fluctuating" exercises with far more variable CQr ranges. Massaging effect helpful 'for a singer in a very rigid or locked approach to their singing' (Hijileh and Pinto, 2021 p. 337)

Transitory semi-occlusion or occlusion